A SURVEY OF THE SPECIES OF TREPOBATES UHLER (HEMIPTERA, GERRIDAE)

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The present paper consists of a review of the generic characters of the American water-strider genus *Trepobates* Uhler, the description of a new form, tables for the separation of the species, and discriminative and distributional notes on the eight species now known. In 1894 Uhler proposed the name *Trepobates* to supplant the Hemipterous genus *Stephania* of Buchanan-White, the latter being preoccupied in the Lepidoptera. From *Metrobates* Uhler, *Rheumatobates* Bergroth, *Telmatometra* Bergroth, and other halobatoid genera, *Trepobates* may be separated by the characters of the antennae and legs. Segment I of the antennae is usually slightly shorter, or sometimes a little longer, than II and III taken together. In the males the antennae lack the striking structures peculiar to the members of this sex in *Metrobates* and *Rheumatobates*. The second and third segments, however, are somewhat flattened and thickly pilose beneath (Pl. XII, fig. 11), apparently an adaptation for clasping.

The members of the genus *Trepobates* are rather small and moderately slender, and are not so broad and flattened as those of the genus *Metrobates*. They are very shy, swift, and alert creatures, inhabiting inland bodies of water, and perhaps preferring the quiet coves of the smaller lakes, secluded bays of the larger lakes, and the wider reaches of streams. They are predaceous, feeding largely upon other insects. The coloration is yellow and black, the markings quite variable in a species, yet tending in a long series to follow a general pattern. In some species the dark markings on the dorsal surface are greatly reduced or practically obliterated, whereas in others the color is almost entirely black, the yellow being replaced by black.

Eight species of *Trepobates* are now known. They range throughout the greater portion of the United States and Canada east of the Rocky Mountains, and extend south into the West Indies, Mexico, and Central America. The clothing of the antennae, legs, and genital segments, the male claspers, the proportions of antennal segments, and the connexivum and apex of venter in female are good characters for discriminating the different species.

The genus is monobasic, *pictus* Herrich-Schaeffer being the type. For more than 40 years after the generic name was erected and up to the year 1926 this was the only species recognized in the literature. As a result several species hitherto have been confounded under the name *pictus* and even yet may be found in collections under this specific name. The different species may be separated by the key, figures, and diagnostic notes given in the following pages.

Genus TREPOBATES Uhler

Orthotype, *Trepobates pictus* (H. S.)

Stephania Buchanan-White, Challenger Rept. Zool., VII, 19, 1883, p. 79 (preoccupied).

Trepobates Uhler, Proc. Zool. Soc. Lond., 1894, p. 213; Bianchi, Ann. Mus. Zool. St. Petersburg, I, 1866, p. 70; Kirkaldy, Trans. Amer. Ent. Soc., XXXII, 1906, p. 156; Kirkaldy and Torre-Bueno, Proc. Ent. Soc. Wash., X, 1908, p. 212; Bergroth, Ohio Nat., VIII, 1908, p. 373; Torre-Bueno, Trans. Amer. Ent. Soc., XXXVII, 1911, p. 245; Van Duzee, Cat. Hemip., 1917, p. 430; Hungerford, Sci. Bul., Univ. Kan., XXXI, 1919, pp. 114, 119; Torre-Bueno, Conn. Geol. Nat. Hist. Surv., Bul. 34, 1923, p. 662; Esaki, Ann. Mus. Nat. Hung., XXIII, 1926, p. 139.

Body short, oval, moderately pubescent. Head subtriangular; width of vertex, measured from in front, not greater than length of an eye. Eyes large, placed at back of head, diverging posteriorly and resting partly on pronotum. Antennae reaching beyond middle of body, segment I slightly shorter than II and III conjoined, II usually shortest, IV slightly longer than III. Rostrum reaching to mesonotum. Pronotum in apterous form short, much broader than long, always separate from mesonotum, its front and hind margins nearly straight; in macropterous form longer than broad, the base broadly triangularly produced backwards. Mesonotum in apterous form large, subquadrate, its hind margin truncate except in apterous females of *pictus* (H. S.). Hemelytra reaching beyond apex of abdomen, the coriaceous base with three stout veins, the outer of which is broadest and somewhat strongly setose. Membrane long, truncate and sharply delimited at the base (deälating fracture), with a stout vein paralleling each margin (tending to converge toward apex) and a distinct ridge or fold down the middle.

Front legs stout, the femora more or less bowed; the tibiae simple, flattened within, with an antennal brush before apex; tarsi biarticulate, the first joint scarcely one-fourth as long as the second. Middle legs moderately long, the femora much stouter and shorter than hind femora; only about half as long as the tibiae. Hind legs shorter, the femora slender, nearly twice as long as tibiae. Genital capsule of male cylindrical, symmetrical, the parameres small and more or less hook-like.

Key to Species of Trepobates

A. Males

I. Intermediate legs with femora and basal portion of tibiae clothed within with a fringe of hairs whose lengths are subequally as great as the diameter of the segment at the point where they arise (Pl. XII, fig. 1) II

Intermediate femora and tibiae clothed on their inner margins with much shorter, setose hairs, these never longer than half of diameter of segments where they arise VII

II. Anterior femora with a strong ring-like constriction or impression on upper surface before the apex (Pl. XII, fig. 10) III

Anterior femora not or only very faintly impressed on upper surface before the apex IV

III. Genital segments conspicuously pilose beneath, the first provided along each side beneath with a tuft of long, posteriorly directed, semi-recumbent, brownish black hairs; male claspers as in Pl. XII, fig. 8.
trepidus D. & H.

Genital segments beneath not noticeably hairy, the first without conspicuous tufts of brownish hairs.
comitialis D. & H.

IV. Third antennal segment clothed within with a row of long hairs, these often closely appressed to the segment (Pl. XII, fig. 11); first genital rather thickly clothed beneath with moderately long, erect, pale hairs.
knighti D. & H.

Third antennal segment without long hairs; the first genital not noticeably hairy beneath V

V. Second genital segment thickly pilose beneath; second antennal shorter than third VI

Second genital segment without long hairs beneath; second and third antennals subequal ....*subnitidus* Esaki

VI. Length of first antennal subequally as great as diameter of head; eyes more prominent; clasper shorter and narrower (Pl. XII, fig. 6) ..... *inermis* Esaki
Length of first antennal distinctly less than width of head through eyes; eyes less prominent; clasper longer, broader (Pl. XII, fig. 3) ..... **becki**, n. sp.

VII. Length of first antennal distinctly greater than width of head through eyes; size larger, predominating color yellow; clasper as in Pl. XII, fig. 4 .... *pictus* (H. S.)
Length of first antennal distinctly less than width of head through eyes; length not more than 2.5 mm.; color in greater part black ..... *floridensis* D. & H.

B. Females (*floridensis* is yet unknown)

I. Connexivum produced outward and upward at apex into long curved spines (Pl. XII, fig. 2) .... *knighti* D. & H.
Apices of connexivum not strongly produced II

II. Apical margin of last segment of venter clothed with long hairs (Pl. XII, fig. 7) III
Last segment of venter not ciliate at apex V

III. Posterior femora faintly thickened within before the basal one-third and provided there with a patch of slightly longer hairs (Pl. XII, fig. 9); mesonotum in apterous form truncate behind IV
Posterior femora not clothed with noticeably longer hairs along basal third; mesonotum in apterous form produced backward into a hornlike process (Pl. XII, fig. 5) ..... *pictus* (H. S.)

IV. Cilia along apical margin of venter somewhat sparse, becoming shorter toward the median line and distinctly interrupted there (Pl. XII, fig. 7); size larger; diameter of head through eyes distinctly less than width of truncate base of mesonotum in apterous form. . **becki**, n. sp.
Apical venter more thickly clothed with cilia, these longer and not so distinctly interrupted toward the median line; diameter of head through eyes equal to or greater than width of truncate base of mesonotum in apterous form ..... *trepidus* D. & H.

V. Segments II and III of antennae subequal. *subnitidus* Esaki
Segment II of antennae distinctly shorter than segment III VI

VI. Form relatively slender ..... *inermis* Esaki
Form much broader; subtropical ..... *comitialis* D. & H.

Trepobates trepidus Drake and Harris.

Trepobates trepidus Drake and Harris, Proc. Biol. Soc. Wash., 41, p. 27, 1928.

Slenderer and longer than *inermis* Esaki; the color markings variable as in that species. Apterous and alate forms known. Length, 3.00–4.50 mm.; width, 1.40–1.85 mm. (apterous).

Male: Easily recognized by the long, dark colored hairs arising from the sides of the base of the first genital segment. These hairs usually project obliquely backwards from underneath the margin of the last abdominal segment and lie semi-appressed to the first genital, extending to or beyond its apex. Antennae with first segment subequally as long as diameter of head through eyes; formula, 50:25:27:32. Pronotum in apterous form more than half as long as broad. Fore femora strongly bowed, somewhat more strongly and abruptly than in any other species; the upper surface before apex constricted as in *comitialis.* Intermediate legs fringed within as in *inermis,* the hairs with their tips distinctly recurved and longest toward apex of femora. Venter more strongly pilose than in other species; the last segment three times as long at middle as preceding segment. Genital segments with numerous long, somewhat erect, pale hairs. Clasper curved, much stouter than in *inermis* (Pl. XII, fig. 8).

Female: Very similar to *becki,* n. sp. First segment of antennae (45) shorter than in male. Mesonotum truncate behind, the metanotum with a conspicuous patch of hairs. Connexiva hairy along upper margins, their apices not produced. Last venter strongly ciliate at apex, the hairs being more numerous and longer than in related species. Hind femora with a patch of longer hairs before basal third (Pl. XII, fig. 9).

The types, apterous male and female from Soledad, Mexico, and alate male from Gualán, Guatemala, are in the collection of Iowa State College.

Trepobates comitialis Drake and Harris.

Trepobates comitialis Drake and Harris, Florida Entomologist, XII, p. 7, 1928.

Male: Antennal formula, 45:26:29:30; the length of the first segment slightly less than width of head through eyes. Pronotum of apterous form distinctly more than half as long as broad. Front femora strongly bowed, but not so abruptly

or sinuately as in *trepidus,* the upper surface before apex with a distinct annular constriction (Pl. XII, fig. 10). Intermediate femora and tibiae fringed within as in *inermis* (these characteristic hairs are broken off in the type series and the segments were therefore erroneously described as without a fringe). Genital segments not noticeably pilose beneath. Male clasper small, very similar to that of *inermis.*

Female: Very similar to and difficult to separate from *inermis.* First antennal (39) distinctly shorter than that of male. Apex of venter not ciliate. Hind femora without patch of longer hairs along basal third. Connexivum strongly hairy above. Hind tibia longer than one-half of femur.

Length, 3.30–4.00 mm.; width, 1.38–1.80 mm. (apterous).

Originally described from Grenada, West Indies; types in collection of Iowa State College. In addition to the type series there are at hand several examples, including alate individuals, from Weslaco, Texas, collected by M. McPhail. The macropterous individuals have the pronotum formed as in other species.

Trepobates knighti Drake and Harris

Trepobates knighti Drake and Harris, Proc. Biol. Soc. Wash., XLI, 1928, p. 28.

This species is very distinct and easily recognized. The color markings are quite variable. Alate and apterous forms are known.

Length, 3.00–4.30 mm.; width, 1.42–1.60 mm. (apterous).

Male: Antennae somewhat variable, first segment equal to or slightly longer than diameter of head through eyes; third segment provided along lower front margin with a row of very long, fine hairs which generally extend obliquely forward (Pl. XII, fig. 11), these hairs sometimes closely appressed to the segment and therefore easily overlooked. Antennal formula of the apterous holotype 50:25:30:35; winged paratype, 60:30:35:32. Pronotum in apterous form more than half as long as wide. Anterior femora strongly bowed, the upper surface not constricted before apex. Intermediate femora and base of tibiae densely clothed with hairs, the lengths of which are equal to, or even greater than, the diameter of the segment from whence they arise (Pl. XII, fig. 1). First genital segment thickly pilose beneath. Male clasper small, somewhat similar to *inermis* Esaki.

Female: Last segment of venter not ciliate; connexiva always produced outward and upward into long spine-like, hairy processes (Pl. XII, fig. 2). Posterior femora without

noticeably longer hairs along basal third. First antennal distinctly shorter than diameter of head through eyes. Apterous form with mesonotum truncate behind, its sides rather conspicuously hairy along the lateral dark stripe.

Holotype (♂) and *allotype* (♀), taken on Turkey Creek, Hollister, Missouri, by Dr. H. H. Knight, in collection of authors. In addition to the types, numerous specimens of this remarkable species have been examined from Missouri, Iowa, and Arkansas. During the past summer, nymphs and adults were taken on a sluggish stream at Ardmore, Oklahoma, by Mr. D. E. Beck.

Trepobates subnitidus Esaki

Trepobates subnitidus Esaki, Ann. Mus. Nat. Hung., XXIII, 1926, p. 141, fig. 6, j–l.

Originally described from two apterous females taken at Clark Junction, Indiana, July 4, 1904, and now deposited in the collection of the Hungarian National Museum. A male taken with the types and a female from the type locality are before the writers. The latter agrees with the original description. The male has the clothing of hairs on intermediate legs similar to *inermis* and other related species. A female from Woodville, Mississippi, August 9, 1921, C. J. Drake, and a male from Summit, Mississippi, September 4, 1926, H. M. Harris, also agree with the description of this species in having the second and third antennal segments subequal. The Mississippi specimens tend to be paler, with a preponderance of yellowish markings, than the examples from the type locality. For a better understanding of the species material is needed for a study of the male genitalia. The Summit specimen, taken in company with numerous specimens of *inermis,* has the clasper very similar to and perhaps identical with that species.

Length, 3.5 mm.; width, 1.8 mm. (apterous).

Trepobates inermis Esaki

Trepobates inermis Esaki, Ann. Mus. Nat. Hung., XXIII, 1926, p. 4, Fig. *f, i*; Drake and Harris, Proc. Biol. Soc. Wash., XLI, 1928, p. 26.

Apterous form with posterior margin of the mesonotum truncate in both sexes. Femora and basal portion of tibiae of the intermediate legs in the male clothed beneath with long hairs, the lengths of which are subequal to the diameter of the segment bearing them. Male claspers (Pl. XII, fig. 6) short, strongly curved, and quite different from those of *pic-*

tus. Antennal formula, 45 : 27 : 29 : 31 ; the first segment in female tending to be a little shorter than in male. Last genital of male distinctly hairy beneath. Female with margins of connexiva thickly pilose, the base of abdomen above also with a patch of long hairs; venter not ciliate at apex, the hind femora without patches of hairs.

Length, 3.20–4.00 mm.; width, 1.30–1.80 mm. (apterous).

Types, Plummers Island, Maryland; in Hungarian National Museum, Budapest.

This is the most common and widely distributed member of the genus. The antennae, as in *knighti,* vary somewhat in total length and in proportional lengths of the segments. Specimens have been examined from New York, Maryland, District of Columbia, Ohio, Illinois, Iowa, Nebraska, Kansas, Missouri, Tennessee, Mississippi, Louisiana, Texas, and British West Indies.

Trepobates becki, n. sp.

Apterous form: (Male) Somewhat similar to *inermis* Esaki, but slightly more robust. Body above black, marked with an irregular and interrupted broad, testaceous or fulvous stripe on each side. Antennae dark, the basal portion of segment I testaceous; formula, 45 : 27 : 29 : 31. Pronotum silvery pubescent on the sides. Anterior femora strongly curved, yet not so abruptly as in *trepidus,* the upper surface faintly depressed before the apex. Femora and basal portions of tibiae of intermediate legs thickly clothed within with moderately long hairs. Body beneath conspicuously pilose, the second genital segment beneath with long, nearly erect, pale hairs on its disc, its sides without conspicuous tufts of darker hairs. Clasper broad, sharply curved, distinctly longer and stouter than in *inermis* (Pl. XII, fig. 3). Length, 4.00 mm.; width, 1.68 mm.

Macropterous form: Pronotum black, broadly margined behind with fulvous, a broad stripe along each side leading from near anterior margin to base, fulvous. Wings brownish black. Last venter of female (Pl. XII, fig. 7) provided along apical margin, except toward the middle, with long, dark brown hairs. Posterior femora in female faintly enlarged at basal third and clothed there with slightly longer hairs. Length, 5.48 mm.; width, 1.7 mm.

Holotype, apterous male; *allotype,* winged female; and *paratypes,* winged male and female; all taken from a sluggish stream at Colonia Dublán, Juarez, Chihuahua, Mexico, July 23, 1931.

Named in honor of the collecter, Mr. D. Elden Beck. A mutilated apterous male and female, from Tucson, Arizona, undoubtedly belong to this species. The latter are very pale, with the yellow markings predominating, and in this respect remind one of the typical coloration of *pictus*. It is very difficult to distinguish the females of *becki* from those of *trepidus*, the former being a little larger, more strongly widened posteriorly, and having slightly smaller eyes.

Trepobates pictus (Herrich-Schaeffer)

Halobates pictus Herrich-Schaeffer, Wanz. Ins., VIII, 1848, p. 111, figs. 882, 883; Uhler, Proc. Bost. Soc. Nat. Hist., XIX, 1878, p. 437.

Stephania pictus B. White, Challenger Rept. Zool., VII, 1883, 79; Uhler, Stand. Nat. Hist., II, 1883, p. 270.

Trepobates pictus Uhler, Proc. Zool. Soc. Lond., 1894, p. 213; Torre-Bueno, Jour. N. Y. Ent. Soc., XIII, 1905, p. 41; Bergroth, Ohio Naturalist, VIII, 1908, p. 372; Van Duzee, Cat. Hemip., 1917, p. 430; Hungerford, Sci. Bull. Univ. Kan., XXI, 1919, pp. 115, 119; Torre-Bueno, Conn. Geol. Nat. Hist. Surv., Bull. 34, 1923, p. 663; Blatchley, Heterop. E. N. Amer., 1926, p. 985; Esaki, Ann. Mus. Nat. Hung., XXIII, 1926, p. 140, figs. 6, a–e.

Color and pattern extremely variable, but yellow markings usually predominant. Alate and apterous forms known. Length, 3.65–4.00 mm.; width, 1.41–1.72 mm.

Male: Antennal formula, 56 : 30 : 32 : 30; length of segment I always greater than width of head through eyes. Pronotum in apterous form twice as broad as long. Anterior femora bowed, the upper surface without noticeable constriction before apex. Intermediate legs clothed within with very short setose hairs. Last segment of venter at middle only two times as long as preceding. Genital segments without conspicuous clothing. Clasper very long and strongly bowed (Pl. XII, fig. 4).

Female: Antennal formula, 42 : 25 : 31 : 32 (in another individual from same locality, 42 : 27 : 35 : 32). Mesonotum (apterous form) clothed with long hairs along sides where lateral stripe bows; produced backward into a stout, hairy, horn-like process (Pl. XII, fig. 5), this process long, cylindrical, and rather sharp-tipped or broad, flattened, and more or less triangular. Connexivum rather hairy, the apex slightly, triangularly produced. Hind femora without patch of longer hairs before basal third. Last venter ciliate with

moderately long hairs, these usually dark but never as long and numerous as in *becki* and *trepidus,* sometimes (specimens from Mississippi) short, pale, and rather inconspicuous.

This is the only species having the mesonotal horn, and as Herrich-Schaeffer specifically mentioned and figured this structure there can be no doubt as to the identity of *pictus.*

Trepobates floridensis Drake and Harris.

Trepobates floridensis Drake and Harris, Ohio Jour. Sci., XXVIII, 1928, p. 273.

Intermediate legs of the male provided with short setose hairs along the inner margins of the femora, the hairs being much shorter and stiffer than in *inermis.* Hind legs with tibia one-half as long as femur. Antennae short and slender, the length of segment I distinctly less than width of head through eyes, II and III about subequal and each half as long as I. Pronotum half as long as broad. Genital segments with clothing hairs not conspicuously longer than those on rest of abdomen. Length, 2.5 mm.; width, 1.00 mm.

Holotype (♂), Florida, in the collection of the authors.

This species is known only from the apterous male type from the eastern part of Florida. It is of peculiar interest because of its size, being by far the smallest member of the genus. The size alone will suffice to distinguish it from its congeners.

Explanation of Plate XII.

(Drawings by Mrs. E. L. Travis.)

Fig. 1. Intermediate leg of male of *Trepobates knighti* D. & H.
Fig. 2. Abdomen of female of *Trepobates knighti.*
Fig. 3. Clasper of male, *T. becki.*
Fig. 4. Clasper of male, *T. pictus* (H. S.).
Fig. 5. Mesonotum of apterous female, *T. pictus.*
Fig. 6. Male clasper, *T. inermis* Esaki.
Fig. 7. Apex of venter of female, *T. becki* n. sp.
Fig. 8. Male clasper, *T. trepidus* D. & H.
Fig. 9. Posterior leg of female, *T. trepidus.*
Fig. 10. Anterior femur of male, *T. comitialis* D. & H.
Fig. 11. Antennae of male, *T. knighti.*